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Applicants: McCallister, et al.
Serial No.: 10/718,507
Filed: November 19, 2003

Group Art Unit: 2611
Examiner: CORRIELUS, Jean B.

For: CONSTRAINED-ENVELOPE DIGITAL-COMMUNICATIONS TRANSMISSION SYSTEM AND METHOD THEREFOR

INVENTOR'S DISCLOSURE AND DECLARATION UNDER 37 C.F.R. 1.56

I, Ronald D. McCallister, a named inventor in the above-identified reissue application, make the following disclosure and declaration pursuant to my obligation under 37 C.F.R. 1.56 to make known to the Patent Office any information believed material to the issue of patentability or that refutes or is inconsistent with a position the applicant takes in asserting an argument of patentability. I am not currently affiliated with the assignee of the application and have no interest in the application. The assignee has questioned my integrity in its prior papers and thus I make this submission in the form of a declaration to remove any doubt that the purpose of my submission is to satisfy my Rule 56 obligation. The assignee apparently believes that pecuniary interests can trump an inventor's duty of candor to the Patent Office. I disagree vehemently with the assignee's view of the patent application process and my obligation as a participant in that process to protect its integrity.

Initially, the Examiner's acknowledgement of my prior submissions dated July 5, 2005 and August 16, 2006 is appreciated. Because of subsequent determinations by the Examiner based on positions taken by the assignee, I believe it is necessary to make this further submission pursuant to my disclosure obligation.

My disclosure concerns the May et al. prior art reference ("Reducing the Peak-to-Average Power Ratio in OFDM Radio Transmission Systems," published May 18, 1998 in the Proceedings of the 1998 Vehicular Technology Conference), which is of record in the application. The present reissue application was filed because I informed the assignee in 2003 that I believed the May reference precisely describes the peak reduction concept of the present application. Subsequent investigations and analyses on my part have only served to confirm that the May reference anticipates or renders obvious nearly all of the subject matter of the application. I make this submission to explain how a number of claims which have been indicated allowable if rewritten in independent form are clearly identical to the teaching of May et. al. I also describe herein important differences in implementation details between May et al. and the present application. However, these differences do not constitute patentable distinctions with respect to many of the claims of the present application which were indicated allowable if rewritten in independent form in the July 17, 2007 Office Action.

In the Office Action dated July 17, 2007, dependent claims 6-10, 24-27, 47-51, 55, 61 and 62 of the present application were indicated allowable if rewritten in independent form. I believe the Examiner has incorrectly made a number of these determinations of allowability based on misrepresentations and mischaracterizations made by the assignee and its expert throughout the entire course of prosecution of the application as, e.g., discussed in my prior submissions. I explain below why at least dependent claims 6-9, 24-27 and 47-50 should be rejected.

Comparison of Functional Architectures

To aid the Examiner's understanding as to which of the claimed subject matter is either anticipated or rendered obvious by the May reference when combined with the knowledge of a person skilled in the art, I begin with a brief review of the May reference and the peak-reduction approach it describes. The purpose is to translate the text and equations of the May reference into a corresponding functional architecture for comparison with the architecture and claims of the current application.

I will then briefly review the peak-reduction approach described in the present patent application, clarifying several terms used in the application to aid in comparing this approach to the May reference.

Once the two approaches are clearly described, it will be clear to anyone skilled in the field of peak-reduction processing that, at their broadest levels of disclosure and implementation, the May reference and the present application and claims are directed to the same peak reduction concept. It will be clear that many of the claimed distinctions in the specific manner in which this core concept is exploited are illusory. It will also be clear that the present application and the May reference differ in one significant implementation aspect, and that the approach of the present application offers peak reduction benefits superior to the approach described in the May reference only if this aspect is implemented.

May et. al. Functional Architecture

The relevant portion of the May reference is found on page 2475, at the bottom of the second column, where the following three equations precisely describe May et al.'s peak-reduction approach:

$$c(t) = s(t) + k(t), \tag{1}$$

$$k(t) = \sum_{n} A_n g(t - t_n), \quad \text{and,} \tag{2}$$

$$A_n = -\left(\left|s(t_n)\right| - A_0\right)\frac{s(t_n)}{\left|s(t_n)\right|} \tag{3}$$

Where:

$s(t)$ ≡ input signal which is to undergo peak-reduction

$c(t)$ ≡ output/corrected (peak-reduced) signal

$g(t)$ ≡ auxiliary function

$k(t)$ ≡ correcting signal

t_n ≡ instants at which the signal peak amplitude exceeds the defined amplitude threshold, A_0. For notational simplicity, these time instants are referred to herein as 'peak-instants'.

The above definitions are taken from pages 2475 and 2476 of the May reference. The equation numbers are added to support more precise references in the discussion below.

Equation 3 above instructs the generation of a unique scale factor, A_n, for each peak-instant, "the positions t_n of amplitude peaks," at which the input signal peak amplitude exceeds the amplitude threshold, A_0. Equation 3 clearly shows that each unique scale factor consists of two factors: the magnitude factor is equal to the real value by which the signal peak occurring at t_n exceeds the defined amplitude threshold, A_0; the phase factor is equal to the phase of the original signal at its peak. The latter conclusion follows since $s(t_n)$ equals the signal peak value (which is the product of the signal magnitude at the peak instant and $\exp(j\Theta)$, where Θ is the phase at that peak instant); dividing this quantity by the magnitude of the signal at the peak instant, $|s(t_n)|$, leaves only $\exp(j\Theta)$, the complex phase of the signal at the peak instant. We then see that the input signal is processed to identify each of its amplitude peaks exceeding the amplitude threshold, and that a single (complex-valued) scale factor is determined for each of these peaks.

Equation 2 unambiguously states that the correcting signal waveform, $k(t)$, is generated by centering a fixed pulse-shape at each peak-instant, then scaling each of these time-offset pulse-shapes by the unique scale factor, computed using Equation 3, corresponding to that peak-instant. Equation 1 simply states that, to achieve the desired peak-reduction of the input signal, it is necessary to subtract the correcting signal waveform, $k(t)$, from the input signal, $s(t)$, forming the "corrected signal," $c(t)$.

The May reference makes clear in its first sentence that the OFDM-modulated signal, $s(t)$, is intended to convey data, thus the functional architecture matching the precise mathematical description of the May reference is that shown in Figure 1. Appendix A contains additional detailed discussion of, and justification for, Figure 1.

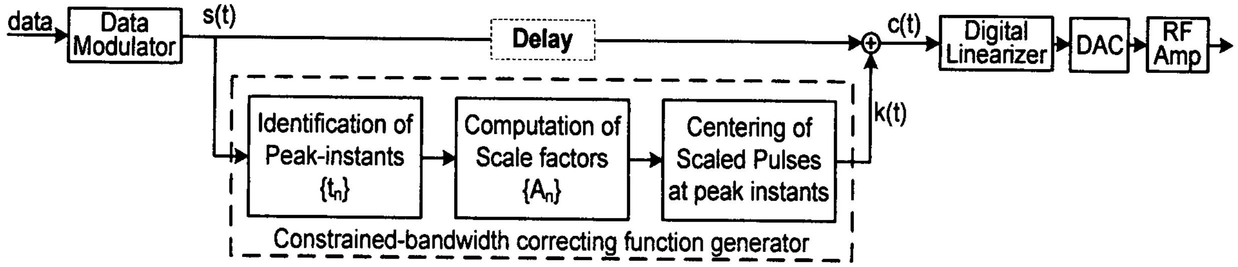

Figure 1. Functional Architecture of the May et al. Peak-Reduction Approach

Functional Architecture of the Present Application

Figure 2 of the present Application Serial No. 10/718,507 may be simplified as depicted in Figure 2 herein, in which the data modulator subsumes the encoder, interleaver, phase mapper and pulse-spreading filter, as is customary. I have eliminated extraneous detail in order to better explain the similarities and differences between these two implementations of the same concept.

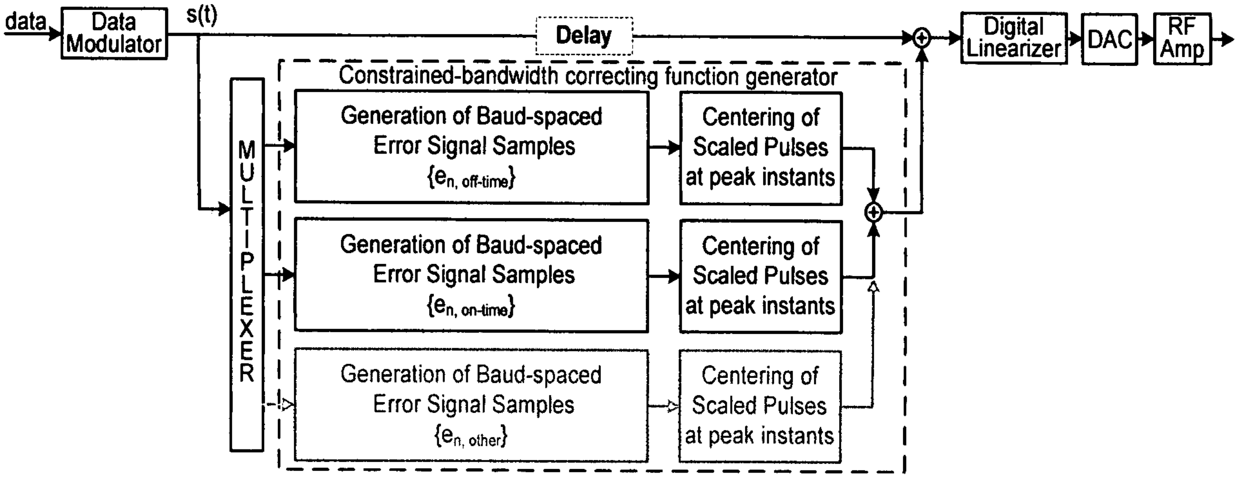

Figure 2. Functional Architecture of the Peak-Reduction Approach of U.S. App. Ser. No. 10/718,507

Quadrature Threshold

I next must clarify a critical ambiguity in the present patent application. It is impossible to implement the approach of the present application without clearly understanding what is meant in the specification by the term "quadrature threshold." The lack of clarity as to this terminology, as well as several typographical errors, makes the proper interpretation of the required processing unlikely. This ambiguity obscures the close relationship between this approach and that described in the May reference.

While all of the engineers at the current assignee's predecessor-in-interest to the present application knew exactly what this "quadrature threshold" terminology referred to, I am not aware that the terminology was used outside that group of engineers at the relevant time or since. Thus, proper clarification of this terminology is essential to an understanding of the similitude of May et al. and the present application.

The threshold itself is a real (i.e. not complex) value, representing the desired maximum magnitude of the peak-reduced signal. However, the term "quadrature threshold" was used in the present application to refer to the fact that this magnitude threshold constraint must be applied to a complex sample value. The application gives no indication as to how this critical combination was to occur. In column 9, lines 13-18, U.S. Patent No. 6,104,761 (the subject of the present reissue application) states that "A quadrature threshold generator 118 generates a quadrature threshold signal 120. In the preferred embodiment, threshold signal 120 is a steady-state, constant signal having a value approximately equal to outer-ring magnitude 68. Threshold signal 120 is used to establish a reference with which off-time signal stream 86 is compared." In fact, the quadrature threshold generator 118 provides the constant real threshold value to the "complex summing or combining circuit 122 to produce an off-time difference signal stream 124." (Col. 9, lines 26-28). Thus, for each sample in the baud-spaced signal stream 86, the corresponding "quadrature threshold" value is a complex value whose magnitude equals the defined real threshold, and whose phase is identical to that of the baud-spaced off-time signal sample.

The close relationship between May et al. and the present application becomes clearer once the term "quadrature threshold" is properly understood, particularly when one considers equation 3 from the May reference. Using May et al.'s notation, the quadrature threshold, QT(n), corresponding to a sample of the filtered signal at time t_n is equal to

$$QT(t_n) \equiv A_0\left[\frac{s(t_n)}{|s(t_n)|}\right] \tag{4}$$

The present application specifies that "[t]hreshold signal 120 and off-time signal stream 86 are combined in an off-time complex summing or combining circuit 122 to produce an off-time difference signal stream 124. Off-time difference signal stream 124 is made up of a series of off-time difference pulses 126 whose values are the difference between the values of equivalent off-time pulses 82 and the value of the threshold signal 120." (Col. 9, lines 25-31). The latter sentence erroneously omitted the word "quadrature" and must be read as follows: "Off-time difference signal stream 124 is made up of a series of off-time difference pulses 126 whose values are the difference between the values of equivalent off-time pulses 82 and the value of the quadrature threshold signal." (emphasis added). The intended quadrature threshold signal is as defined above with respect to reference numeral 120. Note also that, although the threshold is constant, the quadrature threshold corresponding to each sample in the baud-spaced off-time sample stream changes on a sample-by-sample basis. The baud-spaced off-time difference signal stream 124 is thus described precisely by the equation

$$D(t_n) = \left(|s(t_n)| - A_0\right)\frac{s(t_n)}{|s(t_n)|} \tag{5}$$

Comparing this equation to May et al.'s Equation 3 (as discussed above) shows the remarkably close relationship between the two implementations of this single concept. However, the implementations differ in the manner in which they avoid subtracting too much away from each peak. Without a solution to this problem each peak would be turned into a deep valley, excessively distorting the signal in exchange for reducing its peaks, and would thus be an impractical method of peak reduction. As discussed above, May et al. solved this problem by subtracting only a scaled pulse from each isolated peak sample. My co-inventors and I solved this problem by multiplexing the filtered signal stream 74 into a set of sub-streams in which every sub-stream sample is separated in time from its nearest neighbor by a full baud-interval. Each of these techniques is a viable solution to the peak-reduction challenge, and the present application provides a viable peak-reduction technique, so long as the constraint on baud-spacing between difference pulse samples is observed.

The critical nature of a full baud-spacing between two successive samples sent to the shaping filter is described in the present application, but several of the pending claims of the application do not contain this critical limitation. I have generated a graphical explanation to make clear why the baud-spacing constraint is necessary to the peak reduction approach of the present application and that without this constraint the approach of the present application is directed to the same concept as the May reference. The following discussion references U.S. Patent No. 6,104,761 (particularly columns 9 and 10 therein).

Figures 3a and 3b below depict the signal magnitude over a time interval in which several samples exceed the defined threshold; the signal is the thick solid line in each drawing. Figure 3a shows three scaled pulses produced by pulse-spreading filter 134 (as described in U.S. Patent No. 6,104,761 – which is the subject of the present reissue application) in response to three off-time error pulses at times $t_{3.5}$, $t_{4.5}$, and $t_{5.5}$. The dashed line of Figure 3a corresponds to the off-time constrained bandwidth error signal stream 108, and equals the sum of these three scaled pulses. Figure 3b shows two scaled pulses produced by pulse-spreading filter 134 in response to two on-time error pulses at times t_4 and t_5. The dashed line of Figure 3b corresponds to the on-time constrained bandwidth error signal stream 108' and equals the sum of these two scaled pulses. This is the innovative contribution my co-inventors and I conceived which is not described or inherent in the approach of May et al. The May et al. approach also exploits the 'invisibility' of scaled pulses whose spectrum matches that of the signal. However, May et al. require that the timing of the signal peak be very accurately located, along with the peak's corresponding magnitude and phase. Our approach simply required that the error samples be scaled (by the identical scaling used by May), and only error samples separated by baud intervals be sent on to the pulse-spreading filter. Note that, in Figure 3a, the sum of the three scaled pulses yields a waveform nearly identical to the signal appearing above the threshold, so that upon subtraction the signal is reduced to only slightly exceed the threshold. We accomplished this without ever having to precisely identify the point in time where the signal peak occurred, which would have required a much higher sampling rate. Figure 3b shows that the match between the portion of the signal over the threshold and the on-time constrained-envelope generated is even better. In either case, we essentially eliminated the signal excursion beyond the threshold, and unlike the May et al. approach, we were able to do this at the Nyquist sample rate, the lowest possible sample rate for the modulated signal. Since power consumption is proportional to the clock/sampling rate used in the processing, our approach accomplishes peak-reduction using less power and complexity as compared to May et al..

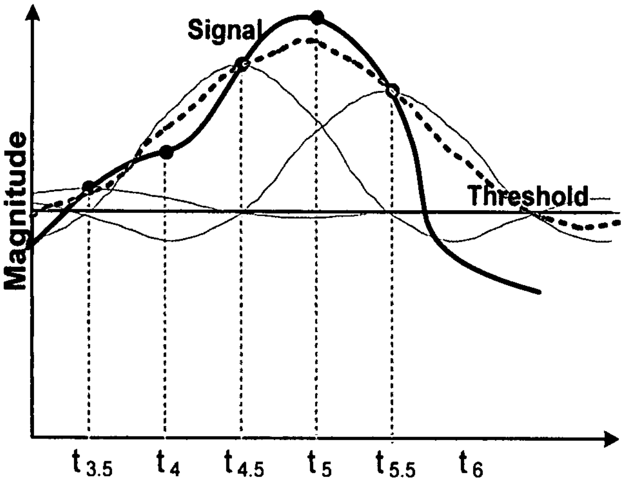

Figure 3a. Off-Time Constrained-Envelope Generator

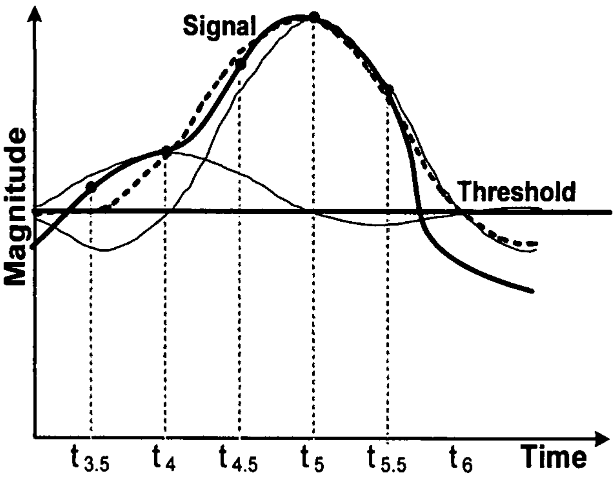

Figure 3b. On-Time Constrained-Envelope Generator

The present application makes clear (columns 9 and 10 of U.S. Patent 6,104,761) that our approach used only the off-time constrained envelope generator, subtracting it from the delayed signal as described in detail in lines 38-48 of column 10. It should be clear from Figures 3a and 3b that only the off-time or on-time constrained-envelope generator output should normally be used. If both waveforms are subtracted from the delayed input signal 140, the result would be to replace the signal peak above the threshold with a signal valley below the threshold; this is known as the "peak-to-valley" phenomenon as discussed above. This is very undesirable, since it degrades signal integrity without reducing overall signal peak magnitude. In fact, modern communication standards limit the amount of such signal distortion, via an "error-vector-magnitude" constraint. Consequently, it is desirable to reduce the signal peak magnitude while subtracting as little as possible in order to have all signal magnitude samples fall below the threshold. A principal benefit of our invention was that it virtually eliminated the need to precisely identify each signal peak, and either on-time or off-time samples yielded improved peak-reduction performance. It is critical to note that acceptable performance demands that some constraint be placed on the set of error samples permitted to pass into the pulse-spreading filter 134. May et al. used a different constraint than my co-inventors and I used; May et al. demanded very precise location of each signal peak, and determination of the magnitude and phase of the signal at that instant. Although both our and the May et al. approaches exploited the same core concept, the nature of the constraint that each placed on the set of scaled error samples permitted into the pulse-spreading filter was quite different.

May et al. modified the set of excursion samples by applying a simple gating on the excursion sample stream: only a single sample from any peak occurring within a set of contiguous excursion samples was permitted as input to the filter. This solved the 'peak-to-valley' problem, but required multiple iterations in order to assure that no signal samples exceeded the threshold. In Figure 3b, for example, application of May et al.'s excursion gating would mean that only the pulse centered at t_5 would be generated in response to this particular set of excursion samples. Note that this simple gating eliminates most of the signal excursion above the threshold. However, since the pulse goes through a zero-crossing at baud intervals away from t_5, the corrected signal magnitude at t_4 would be unchanged, requiring a second pass through the May processing in order to eliminate the resultant signal peak at t_4. Using either on-time or of-time samples results in peak reduction superior to the May teaching in this example.

My co-inventors and I applied a different sample gating to address the 'peak-to-valley' problem; we constrained the set of excursion samples that could be sent on as inputs to the filter by requiring a baud interval separation between any two successive filter inputs. With this constraint on excursion samples serving as filter inputs, note that the peak-to-valley problem is essentially eliminated, regardless of whether the off-time or on-time excursion samples are permitted to pass on to the filter. In the first case, the resulting corrective signal produced by the filter would be the dashed line in Figure 3a, and in the other case it would be the dashed line in Figure 3b. Note how well either case reduces the peak, while assuring that the signal is not driven far below the threshold. The present application's method of modifying the excursion sample stream produces superior results as compared to the approach of May et al. whenever implementation complexity or power consumption constraints limit the implementation to use of only two samples per baud, or to a single peak-reduction iteration.

Review of Core Concept of both May and the Present Application

The central underlying concept of both May et al. and the present application and claims is that arbitrarily-scaled versions of any fixed pulse-shape can be subtracted from any signal without altering that signal's spectrum in any significant way, provided that the Fourier Transform of that pulse matches the spectrum of the original signal. Since peak reduction is an intrinsically nonlinear operation, it must generate noise, but so long as this condition is satisfied, all of the generated noise falls inside the signal spectrum. Since FCC regulatory constraints apply to the transmitted spectrum, satisfying this condition means that signal peaks may be reduced without violating the FCC rules. This "spectral invisibility" condition would actually be satisfied any time the Fourier Transform of the pulse fits inside the signal spectrum, without actually matching it. But as May et. al. demonstrated (Page 2476, col. 1), matching of the two spectra is required to both avoid generating out-of-band interference and to minimize the interfering power of the peak-reduction operation on the original signal. While my co-inventors and I did not include an explicit proof of this requirement in the present application, we were also aware that exact matching of the two spectra is a critical requirement of this concept.

General System Architecture

The generic architecture corresponding to the entire class of peak-reduction systems based on the core concept of the May reference and the present application is depicted in Figure 4. The signal samples are processed to generate the excursion sample stream, and this stream is then modified as needed to avoid the "peak-to-valley" conversion problem, i.e., subtracting too much away from each signal peak, thus generating too much in-band noise in exchange for eliminating all signal excursions. Distinctions between the approaches of May et al. and the present application are due to different approaches to modifying the excursion sample stream.

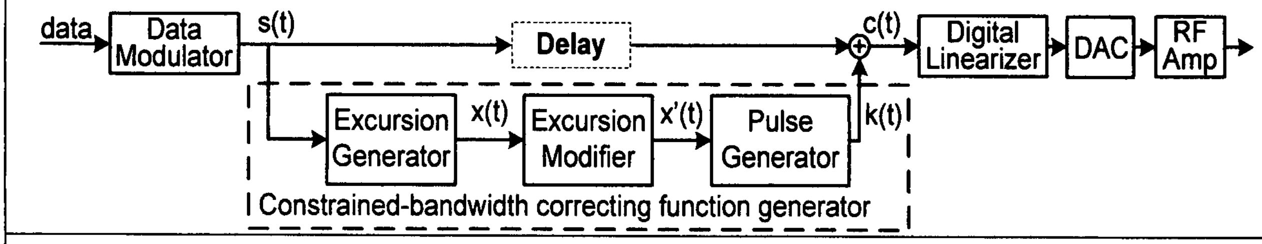

Figure 4. Generic Peak-Reduction Architecture Corresponding to Concept

It is important to realize that a peak-reduction system based on Figure 4 which makes no modification to the excursion sample stream yields a nonviable system. Any viable peak-reduction method utilizing the linear subtraction concept must modify the set of excursion samples so that peaks are reduced to only roughly the threshold, without causing large dips of the signal below the threshold. Claims 24 and 47 of the present application appear to lbe directed to the generic architecture in Figure 4 with no constraint on the set of scaled error samples allowed as input to the pulse-spreading filter. Therefore, these claims should be rejected as anticipated and/or obvious in view of the May reference. Any patent claims having a priority date subsequent to the May et al. publication should be rejected absent some innovative alternative means to constrain the set of scaled error samples passed as input to the pulse spreading filter.

Relationship between First and Second Pulse-Spreading Filters

Dependent claims 9 and 50, which have been indicated allowable if rewritten in independent form, recite that the second pulse-spreading filter must be essentially the same as the first pulse-spreading filter. As explained below, the May reference teaches that this is always the case, whether the first pulse spreading filter implements a sinc pulse or a Root-Nyquist pulse. Any claims covering this straightforward mathematical fact should thus be rejected as unpatentable.

The May reference presents results for peak-reduction using two specific fixed pulse-shapes: a Gaussian pulse, and a sinc pulse. May et al. clearly state their basis for selecting any particular 'auxiliary function' pulse-shape was that "we determine an auxiliary function, g(t), which produces no out-of-band interference." Page 2476, first paragraph, first column (emphasis added). The May reference also states that that "in OFDM systems with a guard interval, a rectangular pulse must be used for modulation. The corresponding pulse spectrum is a sinc function . . . " (May et al., page 474, Section I (Introduction), second paragraph). Any reader skilled in the art would understand these two statements to mean that the stated criterion for selecting the "auxiliary function" pulse-shape is that its spectrum must fit entirely within the spectrum of the input signal. Selecting any "auxiliary function" pulse-shape that doesn't satisfy this condition will result in out-of-band interference, violating the stated condition.

It is known to one skilled in the art of signal processing that the spectrum of any combination of arbitrarily-scaled and concatenated pulse-shapes is proportional to the Fourier Transform of that fixed pulse-shape. Any reader skilled in the art of signal processing would also know that reducing the width of the spectrum of the selected pulse shape to make it even less wide that that of the input signal will result in widening the time-domain pulse-shape -- not only does this extend the range of interference with the original signal, but it complicates the Finite Impulse Response filter used to generate the selected pulse-shape. The obvious conclusion then is that the spectrum of the pulse-shape of the "auxiliary function" should be identical to that of the input signal. This constraint on the spectrum of the 'correcting function' referred to by the May reference is critical, and is clearly required to satisfy May et al.'s stated requirement that the correcting function "produces no out-of-band interference." Again, recall that it is obvious to one skilled in the art that the correcting function spectrum will be a scaled version of the fixed pulse-shape, so May et al.'s requirement implies that k(t) exhibit a constrained-bandwidth. The notion is very simple: appropriately scaled versions of any fixed pulse-shape can be subtracted from the signal without impacting the spectrum of the resulting signal. And since the FCC regulatory spectral masks are defined with respect to the spectral domain, this means that any peak-reduction achieved using this approach [May et al.] has no adverse impact on the signal spectrum.

If the signal being peak-reduced is an OFDM signal with a sinc function spectrum, then the May reference guidelines clearly dictate that the auxiliary function also have a sinc function spectrum, effectively hiding the impact of peak-reduction when viewed in the spectral domain (i.e. where FCC rules apply). It is very apparent to a person skilled in the art that this peak-reduction approach can be applied to other types of modern signal modulations, such as those using Root-Nyquist pulses, and that a Root-Nyquist pulse should be chosen as the 'auxiliary function' for such modulations. The fact that May et al. chose an OFDM waveform to use as an example in this paper should in no way be construed as limiting application of this very general peak-reduction technique to OFDM waveforms. That another popular class of communication waveforms, those using Root-Nyquist pulses, would use a Root-Nyquist auxiliary function seems so obvious as to be trivial. However, to be abundantly clear, I offer the following graphical explanation. Figure 5 depicts the variation in signal magnitude of a data-modulated signal over time. I have positioned the signal magnitude curve such that an amplitude peak occurs in the approximate center, and have scaled a Root-Nyquist pulse according to the teachings of the May reference. It is clear from the graph that forming the corrected signal by subtracting the scaled pulse from the original signal will result in substantially reducing the original signal peak. It is abundantly clear that whether the original signal was modulated using OFDM or Root-Nyquist signaling cannot be discerned from this plot.

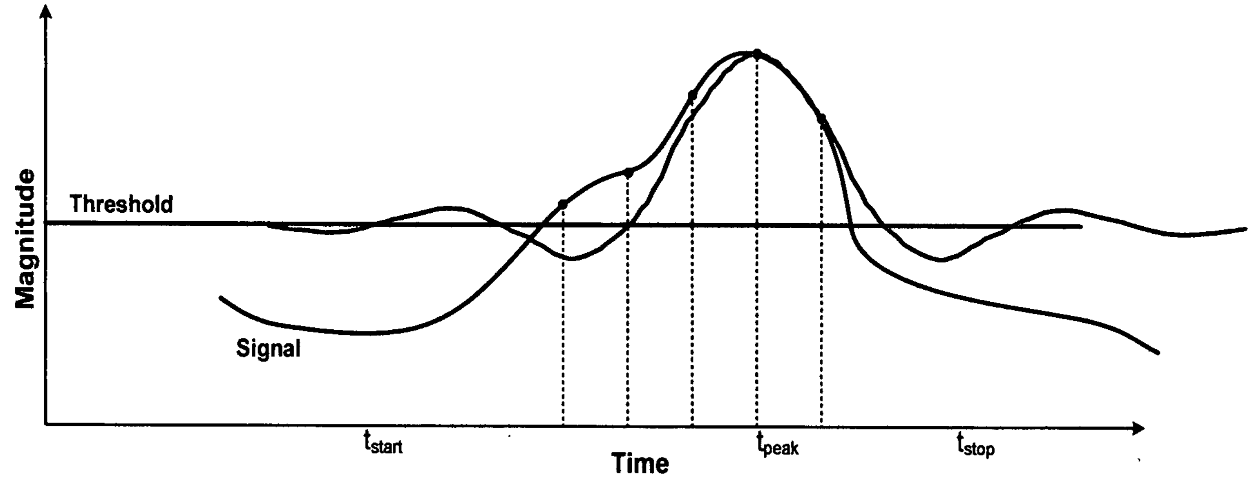

Figure 5. Signal Magnitude vs. Time and Aligned Corrective Pulse

It is impossible from the magnitude-vs.-time plot of Figure 5 to determine which of many potential modulation schemes is being used. There are many variations of OFDM modulation and many variations of classical Root-Nyquist modulations and these <u>various modulation options have absolutely no impact on the effectiveness of peak-reduction using the teaching of the May reference</u>. Regardless of the modulation, May's teaching requires only that each peak exceeding the threshold be reduced by aligning and subtracting a scaled pulse-shape from that peak; peak reduction is achieved via subtraction of the main-lobe of the pulse. It would be technically irresponsible to conclude from the teaching of the May reference that May et al. thought their technique only worked with OFDM signals. A person skilled in the art would conclude the opposite. In fact, at column 6, lines 55-59 of U.S. Patent No. 6,104,761 it is specifically noted that this technique is applicable to OFDM and MTM modulations, as well as Nyquist modulations. Anyone trained in the art would realize that the peak-reduction technique is applicable to any signal modulation type, so long as the corrective signal shaping pulse spectrum is identical to the signal modulation spectrum.

<u>Sinc Pulse vs. Root-Nyquist Pulse</u>

Several claims of the present application which have been indicated allowable if rewritten in independent form (claims 6-8, 24-27 and 47-49) recite the use of Nyquist pulses, rather than the sinc pulses described by the May reference. The mechanism by which peak reduction is achieved depends strongly on the pulse shape used. Consideration must therefore be given to whether peak-reduction performance is significantly improved by using a Root-Nyquist pulse in place of the sinc pulse characterized in the May reference. Again, I offer a simple graphical example to address this question. Figure 6 below depicts a sinc pulse and a Root-Nyquist pulse on the same time-axis; the Root-Nyquist pulse uses an alpha value of 0.22, identical to that used in all 2G and 3G worldwide CDMA communications. It is clear that use of a Root-Nyquist pulse has virtually no impact on the effectiveness of peak-reduction; the main lobe of these pulses are identical to the eye, and accomplish virtually identical peak reduction. Note also that the sinc pulse exhibits the same zero-crossings and peak locations as the Nyquist pulse, rendering all claims citing this as a unique benefit without merit.

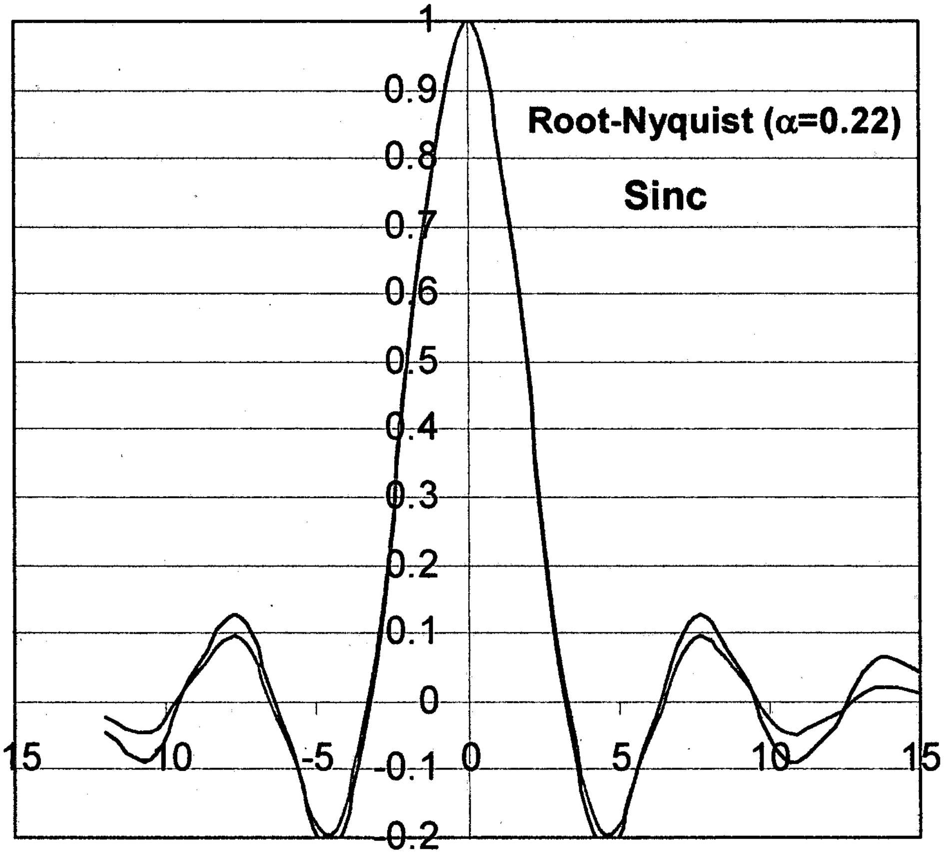

Figure 6.

Root-Nyquist Pulse vs. Sinc Pulse Time-Domain Waveforms

If a Root-Nyquist signal is applied to any implementation of May et al.'s peak-reduction teaching, using either a Root-Nyquist or a sinc pulse-spreading filter, the May approach requires that the "constrained-bandwidth error signal stream in each unit baud interval substantially equals the sum of said Nyquist-type error burst from a plurality of error pulses" as recited in claims 47 and 48. The constrained-bandwidth signal produced by driving either a Root-Nyquist or a sinc filter by any sequence of error pulses must always exhibit the claimed property; it is a direct consequence of the sinc and Root-Nyquist common pulse-shape feature, that of baud-separated peak and zero-crossings.

The May reference teaches driving a pulse-spreading filter with samples that are mathematically identical to samples of the difference pulse stream described by the present application. As discussed above, the May reference teaches elimination of the problem of turning unwanted signal peaks into unwanted signal valleys by gating all such positive-polarity difference pulses so that only those pulses corresponding to signal peaks are inputs to the pulse-spreading filter. As also discussed above, the present application addresses the peak-to-valley problem by gating all such positive-polarity pulses so that only those separated by a baud interval are inputs to the pulse-spreading filter. Applying either of these restrictions on the set of samples greater than the threshold which are actually passed to the pulse-shaping filter as inputs yields a viable peak-reduction technique. The prior teaching of the May reference thus renders unpatentable any claim that does not include some novel restriction on the samples that actually drive the filter (i.e., a restriction other than May's described approach of gating all positive-polarity difference pulses so that only pulses corresponding to signal peaks are inputs to the pulse-spreading filter, and which would not have been known to a person skilled in the art). Therefore, any claims of the present application not including the baud interval constraint, to the extent such claims are adequately supported by the specification, are invalid in view of the May reference.

It is thus clear that a sinc pulse and a Nyquist pulse are virtually indistinguishable from one another from a peak reduction perspective. It is thus equally clear that Root-Nyquist modulation is an obvious variant to the pulse modulation described in the May reference. Since many modern communications systems use Nyquist signaling, it follows directly from this fact and the requirement that the corrective signal shaping spectrum is identical to the signal modulation spectrum (discussed above) that Nyquist pulses would be used for the peak-reduction processing in such systems and that such use was known well prior to the present application. Any claims relying on use of Nyquist pulses as a basis for patentability should thus be rejected.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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Dated: September 12, 2007

Appendix A: Additional Discussion of Figure 1

The delay operator in Figure 1 is not explicitly defined by the May reference, but as I have previously explained in my July 5, 2005 submission, it is impossible to center the scaled pulses at the peak instants without delaying the input signal by at least half the duration of the selected pulse-shape. Otherwise, at the instant that a peak-instant is first identified, the system would already had to have been subtracting the leading edge samples of the scaled pulse-shape from the input signal samples -- before the corresponding peak-instant occurred in that input signal. If the input signal on the upper path is delayed by an amount equal to half the pulse-shape duration, and since that peak-instant identification and scale factor computation occurs in negligible time, then the system can immediately begin subtracting the scaled pulse-shape from the input signal, thereby accomplishing the teaching of May et al. Over two years have passed without a substantive response from the assignee or the assignee's expert since I first explained this in my July 5, 2005 submission. With no example of an implementation of the May et al. teaching anywhere in the asssignee's or its expert's submissions that does not require such delay, I assume this point is finally settled. The simple fact is that May et al. would never have been able to generate their simulated results without using delay.

Note in Figure 1 that I have referred to the sequence of operations defined in the May reference as a 'constrained-bandwidth correcting function generator.' Any engineer skilled in the signal processing art would know that the spectrum of any waveform generated by the three operations shown in Figure 1 will be proportional to the Fourier Transform of the 'auxiliary function' pulse-shape. The constrained-bandwidth correcting signal, k(t), produced by the sequence of operations shown in Figure 1 is a central aspect of the May et al. approach.